

# SAMPLE to diagnose nutrient disorders

**A REGULAR TESTING PROGRAM AND FINE-TUNING NUTRITIONAL INPUTS CAN PREVENT PLANT PROBLEMS.**

By Karen Kackley, Shannen Ferry and Cari Peters

A testing program for nutritional monitoring is like preventive medicine. By following a regular testing program and by fine-tuning nutritional inputs, plant problems can be prevented. Once nutritional problems occur, the focus turns from prevention to diagnosis and correction. Proper sampling techniques for determining nutrient disorders are different from regular nutritional monitoring. Careful examination and sampling of plants increases diagnosis speed and accuracy. It is important to

remember that the quality of the diagnosis is only as good as the quality of the samples.

**BEST SAMPLING TECHNIQUES**

Carefully examine the crop and determine the best sampling technique for the problem encountered. Here's how:

**Define the problem.** What is the species or cultivar that is affected and what is normal for the plant?

**Examine the entire plant.** Look for a full range of symptoms. Examine the roots as well as the shoots and leaves. A fungal root rot can cause symptoms of nutrient deficiency on the above-ground portions of a plant.

**Determine the pattern of symptom development on individual plants.** Do symptoms appear

**WHERE TO LOOK**

LEAF LOCATION/TYPE	DEFICIENCY OR TOXICITY SYMPTOM
Lower leaves/fully mature	Deficiencies of macronutrients: nitrogen, phosphorus, potassium and magnesium. Potassium deficiency is often located on leaf edges/margins. Toxicities of micronutrients: iron, manganese, copper, boron, zinc. Molybdenum toxicity is rare.
Top leaves/young expanding	Deficiencies of most trace nutrients (iron, manganese, copper, boron and zinc) and calcium.
Middle leaves/most recently mature	Molybdenum deficiency of poinsettias.

**SAMPLING TECHNIQUES**

PROBLEM	STRATEGY
All plants are affected (no good plants).	Follow the general sampling instructions.
Symptoms appear on new or old leaves.	Follow the sampling instructions for comparative sampling between plants (e.g., sample old leaves on poor and good plants if toxicity is suspected).
Specific areas of leaves are affected.	Sample affected and unaffected areas of leaves on poor and good plants.
Specific areas of leaves are affected on all plants.	Sample affected and non-affected areas of leaves.



When trying to determine nutrient disorders, look for a symptom pattern across the crop.



The geranium on the left is showing classic signs of micronutrient deficiency. Collect tissue samples from similar-age tissues of healthy and unhealthy plants.

first on the youngest or the oldest tissue? Define the symptoms. For example, is there interveinal chlorosis (yellowing), marginal burn, leaf spots or leaf curling?

**Look for patterns.** Determine the number of species or cultivars affected. Look for a pattern of symptoms across the crop. Determine whether there are affected vs. non-affected plants. Determine the location of affected plants in the greenhouse range, house or bench. Were affected plants potted in different growing medium or did they receive a different fertilizer regimen? Is the pattern of affected plants uniform over an area or is it seemingly random?

**Delineate the time-development of damage.** Did the symptoms show up suddenly or did they develop slowly? Nutritional problems tend to develop over time while plant injuries, such as those due to improper pesticide applications, may show up rapidly.

**Review growing conditions, weather history and all treatments to the crop.** Good recordkeeping is essential. Environmental, cultural and pesticide injuries can mimic nutritional problems.

**Determine the best sampling method.** After carefully examining the crop and collecting all pertinent information, decide on the appropriate sampling method. If there are clearly affected and unaffected plants of the same species and cultivar, then the best method to use is the comparative sampling method. If there are no

**WHICH DEFICIENCY IS IT REALLY?**

An excess of one nutrient may cause a perceived deficiency of another, when in fact, enough of the other nutrient is already available. Adequate testing using proper sampling techniques for media and tissue plus proper sampling location for tissue are essential in determining the degree of antagonism that may be present.

Use caution when determining nutrient antagonisms to be the cause of a particular nutritional problem. For example, sampling after irrigation with a high micronutrient fertilizer may erroneously lead you to think there is consistently high micronutrients when, in fact, sampling over time will show a temporary spike after a particular irrigation. Sampling a large population of plants for each test as well as sampling frequently over time will provide a better overall picture of crop progress or problems than solitary sampling in a crisis.

EXCESS NUTRIENT	PERCEIVED DEFICIENT NUTRIENT
Nitrogen	Potassium
Potassium	Nitrogen, calcium, magnesium
Sodium	Potassium, calcium, magnesium
Calcium	Magnesium
Magnesium	Calcium
Iron	Manganese
Manganese	Iron, molybdenum
Ammonium nitrogen	Calcium, copper
Chlorine	Nitrate nitrogen
Phosphorus	Iron or zinc first, then copper and other micronutrients
Zinc	Manganese, iron
Copper	Manganese, iron
Molybdenum	Copper

such examples, it is best to use the general sampling method.

#### DIFFERENT METHODS OF SAMPLING CROPS

When something goes wrong with a crop, careful records are the first source of information in determining what caused the problem. Proper selection of water, fertilizer, growing media and tissue for testing is second.

Plant tissue and growing medium samples from the same plants are needed to properly diagnose a problem. Since water-quality data can greatly aid in diagnosis, growers who have not had their water tested recently should send in a water sample with the tissue and medium samples. This method of sampling is useful to determine if a particular nutrient is deficient or in excess. However, it may not work in cases where subtle imbalances or excesses of nutrients exist.

#### TISSUE SAMPLING

Since plant species have different tissue nutrient profiles, only include the tissue from one type of plant in a sample. For instance, do not mix tissue from geraniums, pansies and petunias in one tissue sample. Sample each species separately. In fact, it is best to submit one cultivar per sample.

Additionally, proper selection of leaf age has a large impact on interpretation. Younger tissue will not have a normal calcium level and will have a higher phosphorus level than most recently mature tissue.

Micronutrient levels in young tissue are too changeable to interpret, so most recently mature tissue is best for tissue sampling. The normal nutrient ranges reported on the tissue analysis forms of most testing labs are based on most recently mature tissue. If the tissue you sample is younger or older, do not expect nutrient levels to fall within normal ranges.

Unhealthy roots compromise nutrient uptake, so sampling from plants with healthy roots is necessary to properly interpret test data.

#### GROWING MEDIA TESTING

Tissue analyses should always be

For example, a tissue analysis may indicate low iron and manganese. The question then becomes why are these levels low? There are a number of reasons besides the obvious low levels of iron and manganese in the growing medium. For instance, a high growing

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medium pH could make these elements unavailable or an excess of phosphorus in the medium could antagonize the availability of these nutrients. Each cause requires a different corrective measure.

Using growing medium and tissue analyses together provides the best data on the crop sampled at that time. A tissue analysis alone can not fully explain why something may be happening. Remember that plant metabolism is greatly affected by the growing environment and careful notes on climate, irrigation practices and chemical applications will benefit the interpretation of the data.

#### COMPARATIVE SAMPLING BETWEEN PLANTS

Comparative sampling is the preferred method to diagnose a nutritional problem, but it requires the presence of both unhealthy and healthy plants of the same type and size. The advantage of this sampling is it allows a direct comparison between affected and unaffected plants grown under the same circumstances.

Comparative sampling requires a minimum of four samples: two plant tissue and two media. First, collect symptomatic leaves from affected plants, paying particular attention to the exact location of the leaves on the plant. Next, collect matching tissue samples from the non-affected plants at the same location. If the affected leaves are the fourth and fifth leaves down from the growing tip, sample the fourth and fifth leaves down on the unaffected plants. Finally, collect one composite medium sample from the affected plants and another from unaffected plants. Make sure to sample plants that are the same variety and at the same stage of growth. If all plants are growing poorly, then use the general sampling scenario.

#### COMPARATIVE SAMPLING WITHIN PLANTS

Sometimes it is not possible to diagnose a problem even when sam-

ples from both affected and non-affected plants have been compared. When this happens, it may be useful to compare tissue nutrient levels within plants. Sampling within plants can also be done when a single tissue sample from an affected plant does not readily indicate the problem.

The difference in nutrient levels due to deficiencies and toxicities can

**The difference in nutrient levels due to deficiencies and toxicities can be quite subtle between older and newer leaves.**

be quite subtle between older and newer leaves. In this instance, it is beneficial to compare leaves of different ages on both affected and non-affected plants. This method is also useful for problems caused by nutrient imbalances, since imbalances may cause different symptoms on different portions of the plants.

When toxicities or deficiencies are suspected in older tissue, it is possible to check for accumulation or depletion of the suspected nutrient on leaf margins or tips. Examples are potassium deficiency and boron toxicity. It is possible to test for these by cutting away the affected areas of the leaves and using this material as one sample, then using the remainder of the leaves as another sample. If non-affected plants are available, then similar samples should be taken from them as well.

In all of these scenarios, it is important to send the testing lab corresponding growing media samples along with the plant tissue samples. The information gathered from both media and tissue samples will provide more detailed information on the problem.

*Karen Kackley is technical specialist and Cari Peters is manager of research and analytical services, J.R. Peters Inc., 6656 Grant Way, Allentown, PA 18106; (866) 522-5752; fax (610) 395-0322; kkackley@jrpeters.com; www.jrpeters.com. Shannen Ferry is program director and instructor of horticulture, Coosa Valley Technical College, One Maurice Culberson Drive, Rome, GA 30161; (706) 295-6902; sferrys@coosavalleytech.edu.*



When sampling tissue, include the tissue from only one type of plant in a sample. It is best to stick with one cultivar per sample.